INTRODUCTION

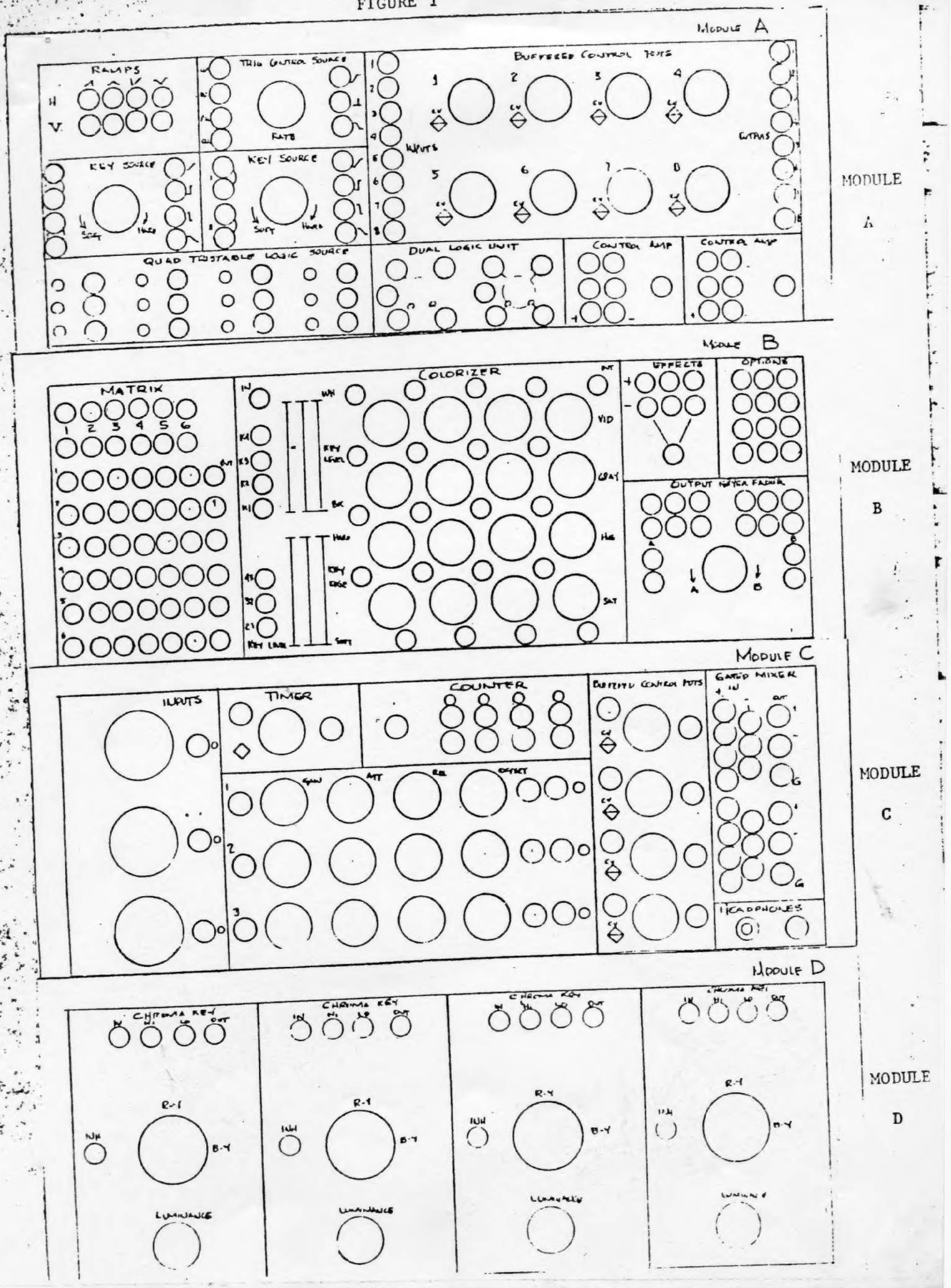
The VideoLab is a highly-flexible modular video synthesizer. The VideoLab accepts up to six video images allowing switching, combining, and modifying of video images in a wide variety of ways. Some of the techniques available include multi-level keys, mattes, fades, dissolves, wipes, multi-level split screens, colorizing and chroma-keying. All special effects including colorizing can be done with soft edges. The VideoLab uses voltage control and patch cords to allow for switching, special effects, and colorizing.

There are four modules in the VideoLab (see Figure 1). Modules A and B are often used together and are capable of producing most of the special effects listed above. Module C, the music interface, provides for producing an automatic sequence of video effects triggered by an audio impulse. Module D, the chroma-keyer, provides four independent, downstream chroma-keyers utilizing joystick controls.

SIGNALS IN THE VIDEOLAB

The VideoLab is operated by bringing video images into the VideoLab and then manipulating the images by means of control and logic signals. There are three types of basic signals in the VideoLab. First there are video signals, video images. Secondly there are control signals which route and manipulate video images. Control signals are variable with an infinite graded range of settings and therefore a wide range of effects. Finally there are logic signals which are similar to control signals except that logic signals are only "on" or "off." Logic signals, therefore, are control signals with only a full "on" or a full "off" capability.

FIGURE 1


MODULE A
RAMPS
TRIG CONTROL SOURCE
RATE
BUFFERED CONTROL POTS
INPUTS
BYPASS
KEY SOURCE
KEY SOURCE
SOFT
HARD
SHIFT
QUAD TRISTABLE LOGIC SOURCE
DUAL LOGIC UNIT
CONTROL AMP
CONTROL AMP
MODULE A
MODULE B
MATRIX
COLORIZER
EFFECTS
OPTIONS
OUTPUT MIXER FADER
MODULE B
MODULE C
INPUTS
TIMER
COUNTER
BUFFERED CONTROL POTS
GATED MIXER
HEADPHONES
MODULE C
MODULE D
CHROMA KEY
CHROMA KEY
CHROMA KEY
CHROMA KEY
R-Y
B-Y
LUMINANCE
MODULE D

JACKS IN THE VIDEOLAB

All jacks on the VideoLab are color-coded to describe the kind of input or output they represent.

RED JACKS are VIDEO OUTPUTS

BLUE JACKS are VIDEO INPUTS

YELLOW JACKS are control signal OUTPUTS

GREEN JACKS are control signal INPUTS

WHITE JACKS are logic signal OUTPUTS

BLACK JACKS are logic signal INPUTS

There are a few exceptions to the above list, but at this point they are of little significance. Improper connecting of jacks on the VideoLab will not result in any damage to either equipment or operator.

DIODES IN THE VIDEO LAB

In many instances there are light-emitting diodes in the vicinity of most jacks. These diodes always light up when the signal is appearing at that jack whether it is an input or an output.

MODULE B

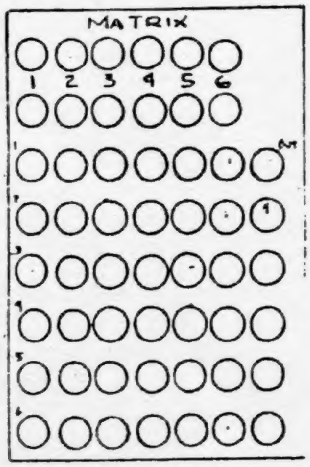
Module B is the main input and output of the VideoLab. Each of the possible six video images enter the Videolab at the 6 b 6 linear matrix. (See Figure 2). These signals enter the VideoLab and then may be patched down to any column in the matrix. A video signal is made available at any column by patching any red jack to a blue jack directly below it with a short patch cord. Now that entire column of jacks below this patch contains the video image. All that is necessary to cause the video signal to appear at one of the red

FIGURE 2

6 BY 6 LINEAR MATRIX

The INPUT of

the VideoLab



output jacks is to apply a control or logic signal at the cross point of the column and row.

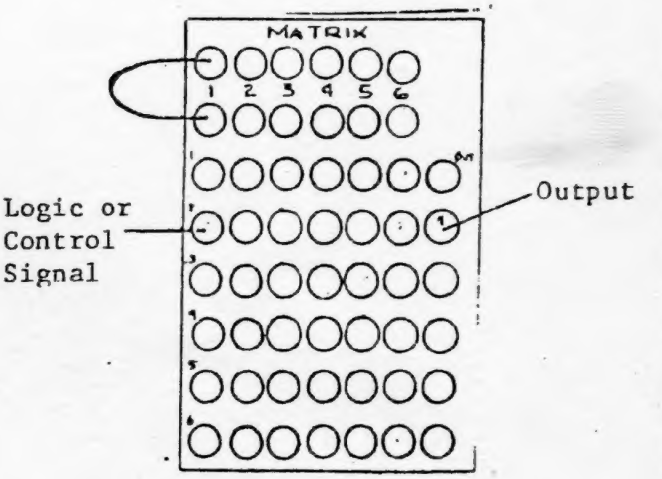
For example, to bring up a video signal appearing at the number 1 input on the red jack of the VideoLab, you patch the number 1 red jack to the blue jack immediately below it. Now if a control or logic signal is fed into any of the green jacks below this patch, the video signal will appear at the red jack immediately to the right of the patch. (See Figure 3). The amplitude or brightness of the image will be proportional to the control level of the logic or control signal.

FIGURE 3

6 BY 6 LINEAR MATRIX

Patching

the Matrix



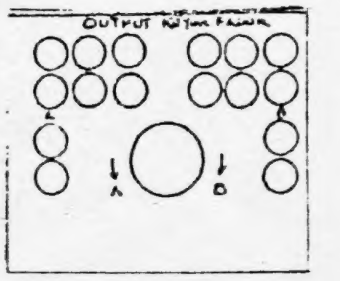
The linear key matrix has the capability of at least three re-entries. Many of the special effects mentioned earlier, including keying, can be done through the linear matrix. Any signal coming into the lab can be steered through the VideoLab by applying control and logic signals to the linear matrix.

The Output Keyer/Fader, which is at the lower right hand corner of Module B is the output of the VideoLab. (See Figure 4). In the upper right and left corners of this Keyer/Fader are a set of six blue jacks. Each bank of blue jacks will mix equally any video signal or signals routed into that bank of blue jacks. So one could patch in up to six video images into each bank of the Keyer/Fader and fade between them by means of the knob labeled "fade."

FIGURE 4

OUTPUT of the

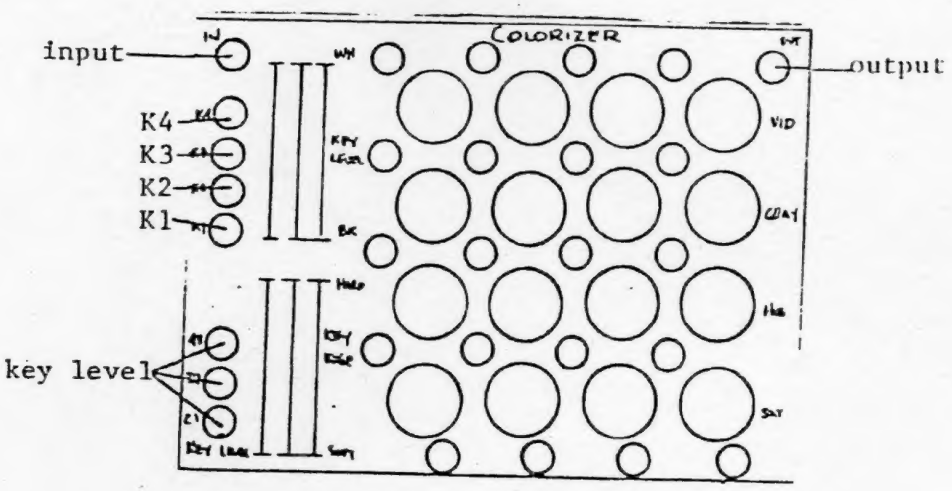
VideoLab



The Colorizer is located between the matrix and the output Keyer/Fader in B Module. (See Figure 5).

FIGURE 5

Colorizer



To understand the linear colorizer it is necessary to have a concept of gray scale in a picture. The gray scale of a picture is directly related to the luminance, the brightness; the white, gray and black of a picture. In photography, Ansel Adams broke up the gray scale into ten zones. The VideoLab Colorizer breaks the gray scale into four zones.

The four gray scale slcies of an image are selected with the slides labeled "Key Level." In this way the incoming picture is sliced in three places by means of the three pots. Slicing an image three times yields four, discrete sections of the image:

the "lowest" level of luminance - the background, the darkets element of the image, any black

the two "intermediate" or "gray" levels - the two separations within the gray levels.

the "highest" level of brightness - the brightest elements on the image, any whites.

Now each gray section of the image may be modified by means of settings on the Colorizer. Each gray slice is colorized by using the series of control knobs under the corresponding number, 1 through 4. The vertical column under number "1" corresponds to the lowest level of luminance, column 2 and 3 apply to the intermediate grays, and column "4" controls the brightest element of the image. So each vertical column of knobs corresponds to one gray slice of the image.

To achieve maximum flexibility of the Colorizer, the control slide pots which slice the gray scale must always be in ascending order with the left pot at the lowest setting.

Once sliced, any gray slice of the picture can be given an arbitrary color, luminance and hue. The bottom control adjusts saturation. This sets the amount of color put on a gray slice. The knob above adjusts the hue of the color. The next knob is labeled "gray" and it adjusts the luminance, the brightness of the picture.

The uppermost knob is labeled "Video." This allows for the insertion of another video image within the confines of each slice. For example, if you feed image 1 into the Colorizer and slice it into four sections, you can now enter a different video image into any one of the four gray slices. You could take image 2 and place it in the lowest level of gray by patching it into the blue jack labeled K1. Then you can adjust the brightness, the level of image 2 by adjusting the knob labeled "video" - the top of the 4 knobs of the Colorizer. So the Colorizer can assign arbitrary colors to any video image as well as key other video image within each of the four slices of the original video image.

The hardness of demarkation points between the four gray slices is variable. It may be set to make the demarkation cleanly defined, "hard," or to make the demarkation "soft." This is accomplished by adjusting the 3 slide control pots labeled "key edge." When colorizing an image, the soft settings allow for a much

more impressionistic range of color gradation rather than the usual hard lines found in most colorizers. This soft/hard feature can also be utilized when inserting additional video into one of the 4 gray slices. So the Colorizer allows for soft color gradations as well as soft keys. Here, as elsewhere in the VideoLab, an important use of the soft edge is that it can be effectively used for noisy images.

Each of the 16 control knobs on the Colorizer has a green control signal input adjacent to the knob. When a control or logic signal is applied to a jack, it will have the effect of turning the knob. The net effect is a mixture of the knob setting and the input control. The knobs are set up so that they have enough range to override the input signals.

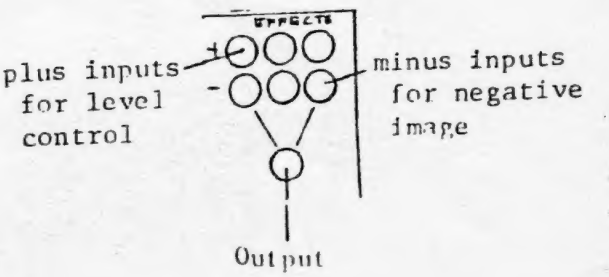
The three green jacks labeled "key level" will accept a control signal which will override the settings of the key level slide pots. In either keying or colorizing this allows for altering the three settings from another control signal generated anywhere in the VideoLab.

The input of the colorizer is the blue jack labeled "IN" at the upper left hand corner of the colorizer section in Module B. The Output is directly across from the input and is a red jack labeled "OUT." The output of the colorizer may be re-entered into the linear matrix or routed anywhere else in the VideoLab.

Immediately to the right of the colorizer in Module B is the Effects Amplifier and a group of white jacks labeled "Options." The Effects Amplifier is an automatic gain control which automatically adjusts the level of incoming video image to a standard level. (See Figure 6). It is like the automatic gain control on audio equipment which adjusts the volume of the audio signal to keep it at the maximum level of volume. To use the automatic

FIGURE 6

Effects Amplifier



video gain control you patch the video image into the row of blue jacks adjacent to the "+" and the adjusted video image is routed out to the red jack below the blue jack inputs. If the signal is fed into one of the three blue jacks adjacent to the "-" sign, the video image will be completely reversed in gray scale and color. This manipulation of the video image results in the complete inversion of the gray scale of the video image and results in a true "negative" image.

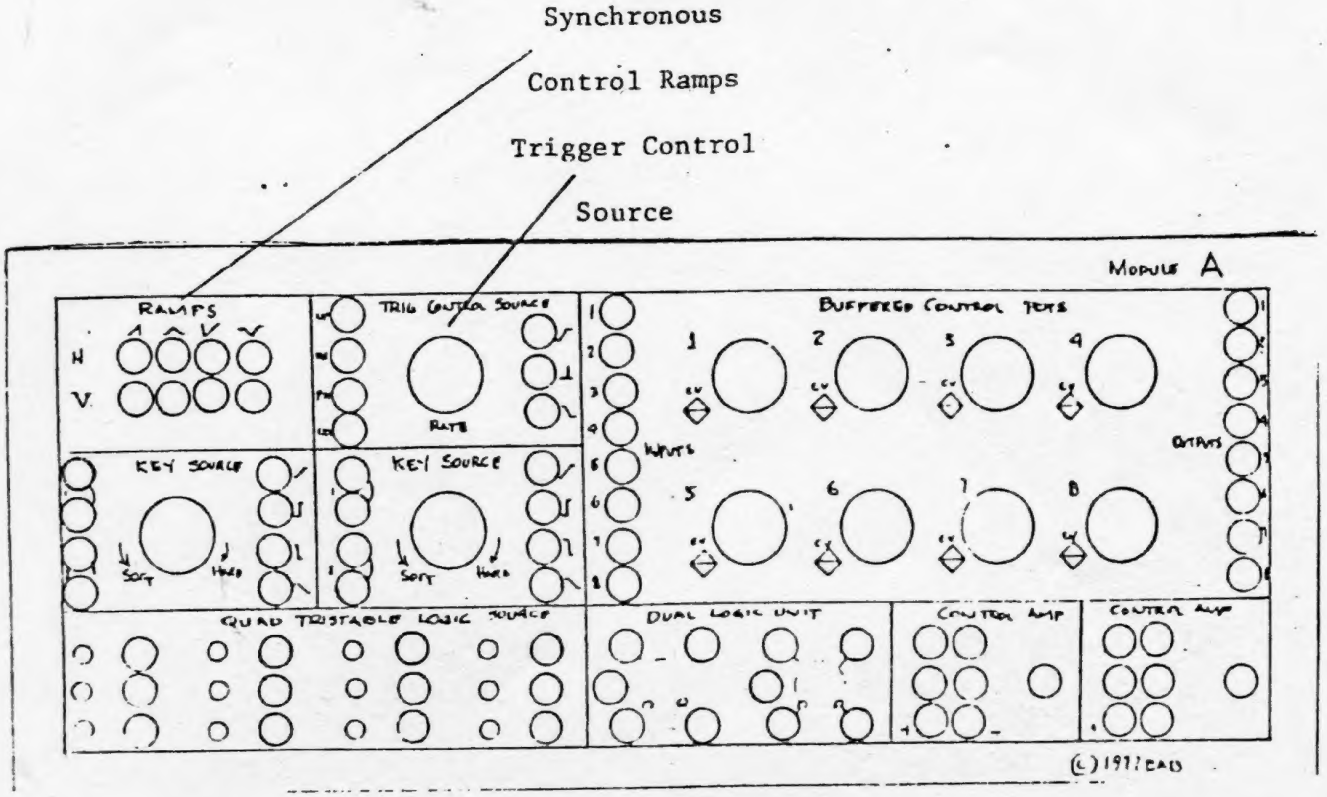
MODULE A

The A Module of the VideoLab contains primarily devices for generating control voltages of two types: control signals and logic signals. These two types of signals are used to manipulate video images in the VideoLab.

In the upper left hand corner are six yellow jacks labeled "Synchronous Control Ramp" (See Figure 7). These are signals which are in sync with the

FIGURE 7

MODULE A



horizontal and vertical frame rates of the video signal. These ramps are used in conjunction with the key control sources to generate control signals which will produce split screens, wipes, corner inserts, etc. They can also be used with the control amps to produce control signals used to manipulate certain, discrete sections of the screen. By tying two or more outputs together, unusual wipes may be created.

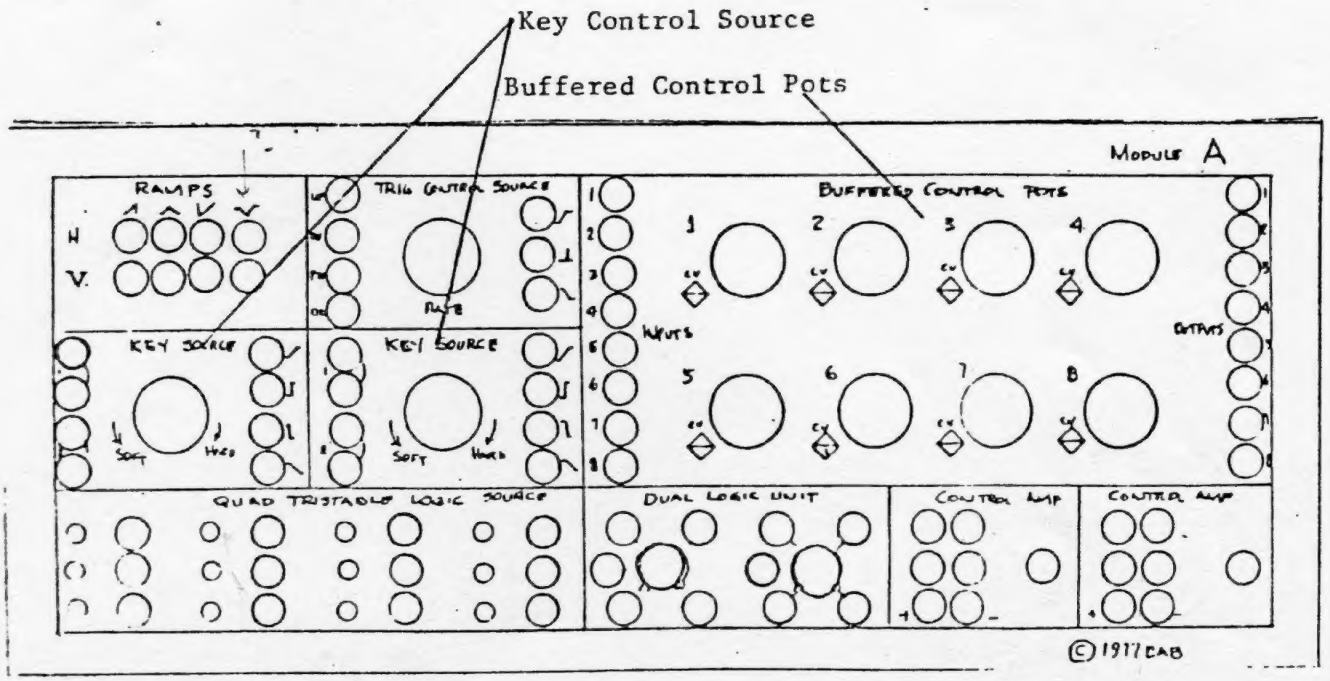
To the right of the Synchronous Control Ramps is the "Triggered Control Source" (See Figure 7). The triggered control source supplies a slowly changing control signal which may be used to generate automatic fades, dissolves or wipes. It is an input/output submodule; i.e. it requires both input and output for operation. The input jacks of the Triggered Control Source are the black jacks indicating they are logic inputs. The outputs are the white and yellow jacks on the right hand of the submodule. The yellow jacks are control signal outputs and the white jacks are logic outputs. The yellow jacks, control signal outputs, generate a slowly changing signal whose rate is adjusted by means of the knob labeled "rate." Remember that control signals are variable, while logic signals are simply on or off. The output signal will go "up" or "down" (i.e. towards full scale or towards zero) depending on which of the black inputs receives a signal.

Each of the "Key Sources" located below the Triggered Control Source, is used to produce a bi-polar, high-speed control signal which is based on the difference between its inputs. An important feature of the key control source is that the output levels are complimentary. Thus when one output is at maximum control signal output, the other is at zero. In this way, keys between two images may be performed by applying complimentary control signals to two points on a row of the matrix switcher.

The standard technique to generate a wipe is to apply a slowly changing control signal to one of the key inputs of the Key Control Source (green jacks) and a synchronous signal to the other input (green jack). The complimentary outputs of the Key Source are then fed back into two cross points on a row of the linear key matrix to provide the control signals for the wipe.

The Key Control Source may also be used to key two video images (See Figure 8). A fixed control signal is applied to one of the inputs and a video signal in the other input. This will cause a control signal to be generated which may be used to steer any two video inputs on or off when fed back to the linear key matrix. This type of key which may be either "internal" or "external" is an extremely useful feature of the VideoLab. The VideoLab performs variable hardness gray level keys which in many applications may be preferred to a chroma key.

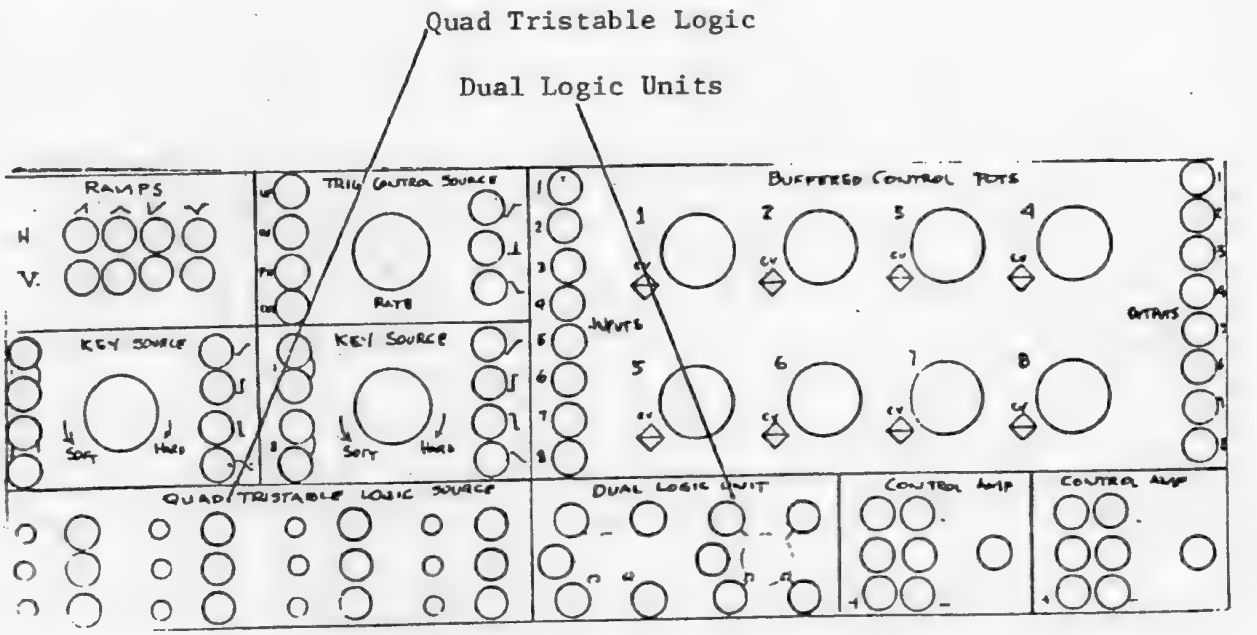
FIGURE 8



Immediately to the right are the Buffered Control Pots. These units have a dual function. They are a source of variable control signals, available on the yellow jacks numbered 1 through 8. The control signal amplitude is determined by the setting on the knob when the small switch labeled "cv" is in the "up" position. When the "cv" switch is in the "down" position the Buffered Control Pots act to attenuate any signal applied to the input jack at the left of the submodule. There are important implications of this feature which will be apparent later.

The submodule on the bottom right corner of the A Module is the Quad Tristable Logic Source (See Figure 9).

FIGURE 9



The white jacks generate logic signals which change only during the vertical blanking interval. Any one of the three logic outputs can be made to go "high" by depressing the red button. Only one of the three can be active at any given time. So one can perform conventional vertical interval switching of various video signals by applying thse logic signals to the linear matrix.

When the logic output is applied to a cross point on the matrix, it will cause the video signal present at that column in the matrix to appear at the output of that row.

Adjacent is the Dual Logic Output. It will accept up to three logic inputs and will sent out two complementary logic outputs. It is used to generate special wipes and inserts. Each of the Dual Logic units may be described as a two-input and gate with an inhibit input and complementary outputs. As with all signals in the VideoLab, when outputs are tied together, the highest predominates. This allows for more flexibility. The "true" (upper) output of the Dual Logic Source will go "high" if both true inputs are high and the false input is low (or unconnected). The false output will always be opposite to the true output. On the panel, the true inputs are the two upper inputs, and the false input is the lower input.

To the right of the Dual Logic Output are two Control Amplifiers. They may be used to create a number of effects such as cross fades and unusual wipes. They are also useful to do outlining.

MODULE C

The Audio-Interface Module C is designed to accept audio inputs from music and produce control signals which may be used to modify video images which are present in Modules A and B.

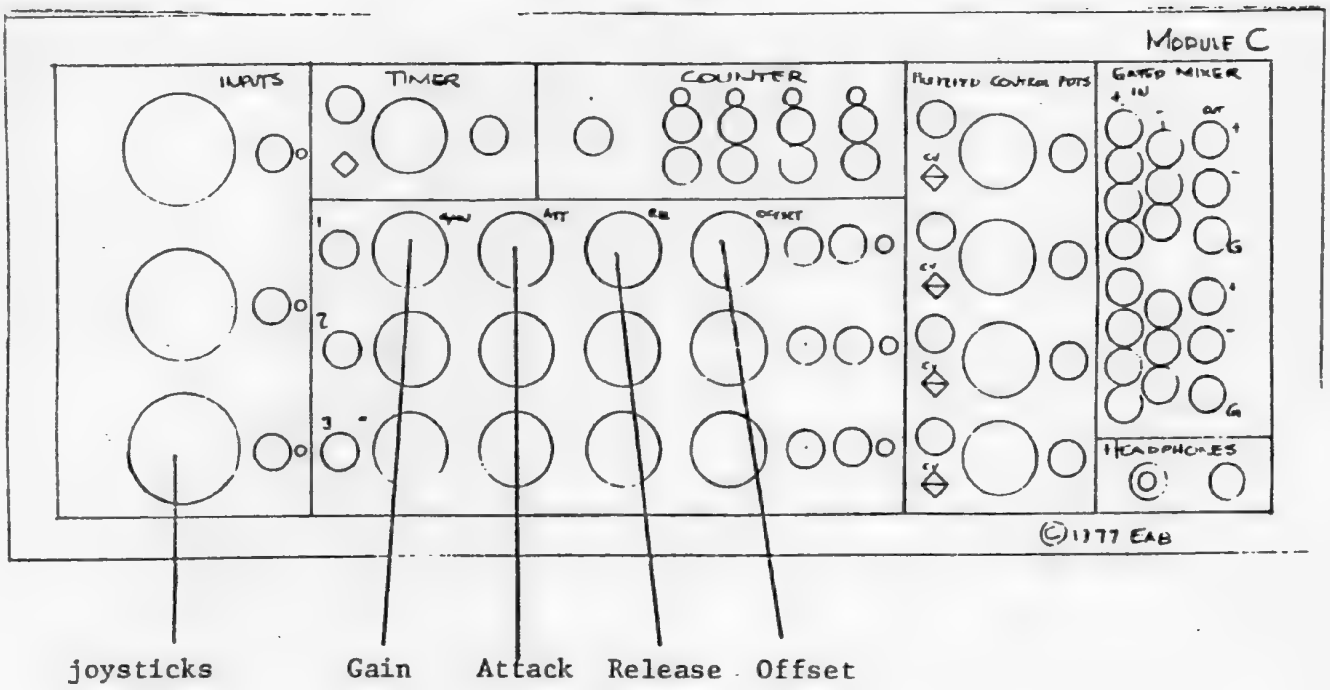
Module C contains filters which select certain frequencies of music. When the desired frequency occurs in the music a control signal may be generated. This control signal may then be modified by other submodules in Module C and be used anywhere in the VideoLab to cause an effect or a series of effects.

A music frequency is selected by the manipulation of the joystick controls at the left of the C Module (see Figure 10). Movement of the joystick to the

FIGURE 10

MODULE C

Music Interface



right or left will vary the frequency being selected. Moving the control up and down will vary the degree of selectivity. The right-to-left movement is a broad tuning, the up-and-down is a more precise selection. The red diode will light when frequencies selected are being "heard" by the audio interface module. Headphones can be patched in to allow the operator to hear the selection process.

The output of the joysticks may be fed into the Audio/CV Convertor directly to the right to form control and logic signals. The purpose of the Audio/CV Convertor is to accept the specific frequencies chosen and generate a control or logic signal. This control signal will be variable in amplitude, attack and release time and its offset. The outputs of the Audio/CV Convertor are complementary; i.e. when one is going up towards full range, the other is going towards zero.

On the right of the Audio/CV Convertor submodule are yellow and white jacks, the control and logic signal outputs. There is an LED indicator next to the white jack. When the output of the Audio/CV Convertor is swinging full range, the diodes will light. This visual cue helps one assess how well the Audio/CV Convertor is being used. The Audio/CV Convertor has such a wide range of attack and release times it is necessary to have this visual feedback to know the signal is being properly processed. The attack and release time setting are essentially smoothing times of a filter which allow for greater shaping and shading of the output control or logic signals.

Above the Audio/CV Convertor are the timer and the counter. The timer has a green input and a white output. It produces pulses which may be used to switch the counter or may be fed directly into the Audio/CV Convertor to form an envelope. The timer will produce pulses at a rate which is controlled by either knob at the center of the timer unit or by a control signal input to the left of the unit. Each time a pulse is produced the light-emitting diode above the white jack will flash.

An important feature of the timer is the switch in the left hand bottom corner labeled V1. This enables the timer to produce logic pulses only during the vertical interval.

The counter has four outputs and the active output is indicated by the LED indicator above the white output jack. The counter may be made into a sequencer by patching it into the inputs of the buffered control pots. A variable control signal will then be available at each of the four outputs and this may be applied anywhere in the system.

To the right of the buffered control pots is the Gated Mixer. The outputs of the Gated Mixer are complementary control signal outputs similar to the

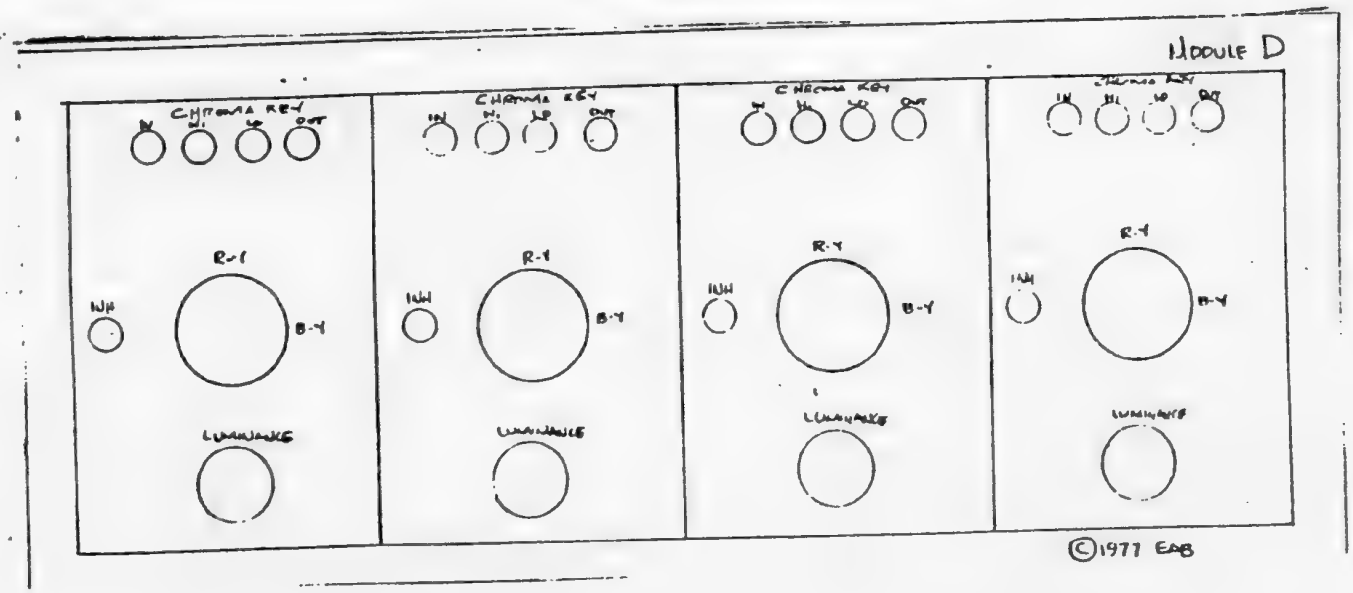
complementary outputs on the Audio/CV Convertors and the Key Control Source. The Gated Mixer has four positive inputs, three negative inputs and a gate input. The output of the Gated Mixer is the algebraic sum of any of the input voltages times the level coming into the unit. The main function of the Gated Mixer is to accept control signals and mix them for use elsewhere in the system.

MODULE D

Module D is a four-channel chroma-keyer (See Figure 11). An image with a constant background color is brought into the blue input jack labeled "in." Conventionally, that image must also be fed into the "low" input. The second image which is to replace the constant color background is then brought into the jack labeled "high." The composite image is available at the jack labeled "output."

FIGURE 11

MODULE D



The joystick and the luminance controls adjust the color selected and the brightness. They are both "internal" controls; i.e. they are used only to select the color and brightness of the area to be replaced, to be chroma-keyed. Moving the joystick changes the selection of the color, and moving the luminance control changes the brightness; i.e. distinguishes between shades while the joystick distinguishes between colors. By careful manipulation of the joystick and the luminance control the chroma-keyer can distinguish between color and hue respectively.

THE EFFECTS MANUAL

The basic description and use of each of the four VideoLab modules should now be clearly understood. The operator's ability to perform effects on the VideoLab can now be best achieved by a careful study of the Effects Manual and actual time on the VideoLab.

The Effects Manual illustrates patch configurations. It is also a means of chronicling complex patch configurations for use at a later date. Study of this manual will aid in the understanding of the VideoLab.

VIDEO LAB Effects Manual

Volume 1

Introduction

The purpose of this manual is to describe and illustrate 12 basic applications of the VideoLab. Additional volumes will be made to log complex patch patterns for future use. This volume contains a descriptive text explaining the logic behind the patching of the 12 effects.

These 12 effects by no means exhaust the variety of effects available with the VideoLab. They are designed to illustrate the basic principles of patching and utilizing various submodules of the VideoLab.

FIGURE 1

This is an example of switching between two video images. The Quad Tristable Logic Outputs #1 and #3 are fed into the linear matrix column 1 and 3, Row 1. The output of row 1 is connected to the Output Keyer/ Fader . Pressing pushbuttons P1 and P3 cause channels 1 and 3 to be cleanly switched (i.e., during the vertical interval).

FIGURE 2

Figure 2 illustrates a cross fade between two images. There are other, simpler ways to accomplish a cross fade, but this pattern illustrates several basic techniques.

A control signal from the Buffered Control Pot #1 is sent to teo Control Amps, driving one positive as it drives the other negative. One section

of the Quad Tristable Logic Source is sued as a full scale control signal source and it drives the right hand section of the Control Amp to full scale when no other input is present. The resultant arrangement produces complementary control signals which are applied to the Row 1 crosspoints as in example 1. The difference in this example and example #1 is that the control signals are changing slowly instead of instantaneously, producing a fade instead of a switch.

FIGURE 3

In figure 3 the crossfade is accomplished automatically by depressing the Tristable Logic Source pushbuttons P7 and P8.

Two important aspects of figure #3 are :

1. A slowly changing control signal may be created by means of the Triggered Control Source.
2. An existing source of manually changed control signal (in this case the Buffered Control Pot #1) may be replaced by another source (without disturbing any patch) by merely connecting the new control source to the input of the Buffered Control Pot and throwing the switch to the "down" position.

FIGURE 4

Figure #4 is a horizontal split screen produced by applying a complementary control signal to Row #2 of the linear matrix (note the similarity to Figure #2). This patch configuration differs from the last 3 figures in the method of producing the control signal.

The control signal is produced by a Key Control Source. It produces a slicing signal by comparing the horizontal ramps with a constant level.

The hardness of the edge of the screen is variable by the setting of the knob on the Key Source submodule. Some important variations of this patch are :

1. Manually changing the Buffered Control Pot #1 will result in a horizontal wipe.
2. Altering the Ramp Outputs will change the shape and direction of the wipe. Horizontal and vertical wipes as well as corner inserts may be created by changing the Ramp Outputs.
3. The patch may be automated as in Figure #3.
4. The upper input to the Key Source need not be a Ramp signal. This is discussed in the next example.

FIGURE 5

Figure 5 illustrates Gray Level Keying. Here an external key is produced by using the video image of channel 6 as a Key Source input and using the resultant high speed control signal to switch between channels #1 and #3. This produces an image which contains the information of channels 1 and 3 within the outline produced by channel 6. Channel 3 appears in the higher luminance (brightness) portions of channel 6; and channel 1 occurs in the lower luminance portions of channel 6. Note that the only difference between this patch and Figure #4 is that the "slicing" control signal is generated from a video signal instead of a Synchronous Ramp.

The key produced need not be an external key. If the Key Source input is channel 3 for instance, the key produced will be of the internal type (i.e. self-keying) where image 3 appears "over" image 1, showing its higher luminance values only.

FIGURE 6

Figure 6 demonstartes the use of the Effects Amplifier. This pattern produces a video signal which is that of channel 1 with its gray scale and colors completely inverted. The effects amplifier may also be used to restore full amplitude and contrast to a signal when the signal is brought in on the positive inputs.

FIGURE 7

Figure 7 demonstrates the use of the Colorizer. Here a totally synthetic video image is produced by slicing the gray scale of a video signal and assigning arbitrary values of hue, saturation, and luminance.

FIGURE 8

Figure 8 shows a mix of colorized video with original video.

FIGURE 9

In Figure 9, only the highlights of the original video image are retained.

FIGURE 10

Module C, the Audio Interface is demonstrated in Figure 10. In this application, the hue of the third gray slice of the video image is changed by the high frequencies of a sound channel and the saturation is being changed by the low frequencies of the sound.

The settings of the joysticks, # 1 and #2, are such that the high frequencies are passed through joystick #1 and the low through #2.

The resultant bandwidth-limited audio signals are then fed into the Audio/CV Convertor where control signals are generated. These control signals are then patched into the Colorizer.

Because of the extreme flexibility of the Audio/CV Convertor, settings must be made with extreme care. The following general steps will aid in obtaining useful control signals :

1. After isolating the frequencies desired by manipulating the joysticks, turn the GAIN setting to zero. Set ATTACK and RELEASE to an intermediate setting, 3.
2. Turn the OFFSET control fully clockwise. The upper LED indicator should light. Adjust the OFFSET control counter closkwise until the lower LED lights.
3. Advance the GAIN control until the LED's light alternately. This indicates that a full range of control signals is being generated.
4. Now that full control signal is being generated, the signal may be attenuated by the Buffered Control Pots.
5. When ATTACK and RELEASE settings are altered, it may be necessary to change the GAIN setting to insure that a useful control signal is being produced.

FIGURE 11

In Figure 11, Cha-nels #1 and #3 are being switched (as in Figure #1), but here they are switched by means of the timer and counter. The maximum rate at which channels 1 and 3 can be switched is every other vertical frame. The switch on the counter is set to the VI position indicating the pulses

occur only in the vertical blanking interval. The timer drives the counter which is fed back upon itself so that it only assumes output states #1 and #2. The rate of alternation of the two images is controlled by the setting of the timer knob.

FIGURE 12

Figure 12 illustrates a typical use of the Chroma Keyer, Module D. In this patch configuration, a video signal from Channel 1 is patched into the input jack of the Chroma Keyer. The Keyer examines this signal for a constant background color and will switch between the two video inputs labeled "HI" and "LO" to ptoduce a video output. When the Keyer does not discern the background color, the Chroma Keyer passes the "LO" video signal to its output. When the background color appears, the Chroma Keyer passes the "HI" video si-nal to its output. When the background color appears, the Chroma Keyer passes the "HI" video signal to its output.

In Figure 12, Channel #2 contains the information which is to be placed in the background of Channel 1. The joystick must be carefully set to detect the required background color. The luminance control should be set so that the Keyer does not recognize inappropriately dark (low luminance) levels of the key color. An external key may be produced by driving the "LO" input with a video signal other than the original.